Coleman Research

Three Dimensional Integrated Characterization and Archiving System (3D-ICAS)

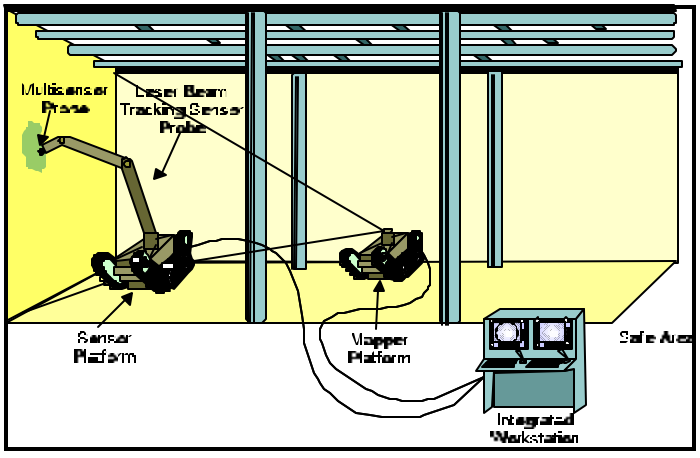
Technology Need:

Characterization sampling and analysis for hazardous organic and radionuclide contamination on concrete, asbestos, and transite is a time-consuming, expensive process with the potential of exposing humans to radiation and hazardous materials. A technology is needed that can perform rapid in situ analysis of hazardous organics and radionuclide contamination on structural materials.

Technology Description:

Coleman Research Corporation has developed an integrated system that remotely characterizes, maps, and archives measurement data of hazardous deactivation and decommissioning (D&D) areas. The configuration consists of a mobile sensor platform and a mobile mapper platform that operate in contaminated areas, and an integrated workstation that remains in a safe location.

During characterization operations the mapper, using its coherent laser radar (CLR), maintains its precise location and reports the positioning of a multi-sensor probe located on a robotic arm extending from the sensor platform. The operator at the integrated workstation, using displayed 3D map information, plans and directs the selection of surface areas to be characterized and the number of samples for a given area. The 3D-ICAS then automatically samples these areas; archives 3D location, time, and concentrations of each contaminant; and provides map displays at the workstation showing contoured contaminated regions.



CLR provides topographical mapping and position references for the chemical and radionuclide information. Molecular Vibrational Spectroscopy (MVS) is used to characterize the type of substrate material and to measure toxic organics down to the low parts per million level. High speed gas chromatography/mass spectrometry (GCMS) with thermal desorption provides definitive measurement of polychlorinated biphenyls and other toxic organics down to the low parts per billion level.

Alpha and beta counting with energy discrimination is used to identify and quantify isotopes of uranium, plutonium, thorium, technetium, neptunium, and americium.

Remote CLR mapping is done using a scanner unit mounted on the mapper platform. Close-in sensing is done using a multisensor head mounted on a robotic arm deployed from the sensor platform. The multisensor probe is designed to carry all of its sensor components, or a selected subset, depending on the characterization mission.

Benefits:

<Improved Performance: The quality of analytical data generated by 3D-ICAS chemical analysis instrumentation will equal or exceed that currently being generated by conventional laboratories. Sample automation and elimination of the extensive sampling handling associated with off-site storage and analysis will improve the reliability

of the data as well as significantly reduce sample preparation time.

<Cost Reduction: Costs for chemical analysis will be reduced because the whole process from sample preparation to data management can be automated and performed on-site.

<Reduction of Health Risks: The automation of sample preparation steps and actual site mapping will eliminate sample handling by laboratory personnel.

<Reduction of Environmental Risks: Using real-time analysis engineers could monitor and respond to problems in less time than is possible with conventional chemical analysis.

<Improved Operations: The robot operated analysis instrumentation will improve the capabilities of the Department of Energy (DOE) response in each of the three phases of remedial efforts by providing a more efficient, streamlined beginning-to-end operational capability.

<Waste Minimization: Procedures can be halted as soon as compliance is achieved, preventing excess of removal of otherwise clean material. More detailed mapping and characterization of the site will identify areas that are in compliance and do not require decontamination.

Status and Accomplishments:

This project was completed in 2001. In 1997, a Phase III integrated demonstration of the 3D-ICAS system was conducted at Oak Ridge National Laboratory (ORNL) using an overhead transporter at ORNL's Robotics and Process Systems Division.

In Phase IV, a field demonstration of the 3D-ICAS system was conducted at Florida International University (FIU). The objective of this demonstration was to show the operation of the system mounted on the mobility platform. The platform conveys the coherent laser range mapper, sensing robot arm subsystem, contaminant analysis unit, and multi-sensor probe.

In this demonstration, the contractor was able to demonstrate the CLR mapping and the movement of the sensor probe to selected locations on the test wall. Two maps were successfully made of a 1mx2m area and the CLR's micrometer-range accuracy was demonstrated. The robotic arm and sensor probe successfully surveyed a multiple-point set. The X-Ray Fluorescence (XRF) sensor for heavy metals detection was demonstrated but the GCMS sensor had failed. The cause of the GCMS failure is believed to have resulted from field debugging, required after delivery of the wrong phase power supply to 3D-ICAS. The loss of time for repairs prevented the demonstration of the radionuclide detectors.

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Online Resources:

Office of Science and Technology, Technology Management System (TMS), Tech ID # 97
http://ost.em.doe.gov/tms

The National Energy Technology Laboratory Internet address is **http://www.netl.doe.gov**

For additional information, please visit the Coleman Research Corporation website: **http://www.crc.com/**